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(54) **Electroplating cell anode.**

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Description

The present invention relates to an anode for an electrolytic plating cell for plating continuous strip, and particularly to an anode having a replaceable, electrocatalytically coated active surface.

Electrocatalytically coated anodes for continuous electrolytic coating of large objects, for instance metal plating of steel coils, are well known. An example of an electrolytic deposition process is electrogalvanizing strip steel. For such deposition, a substrate metal such as steel in sheet form, feeding from a coil, is passed through an electrolytic coating cell, often at high line speed. Electrocatalytically coated anodes for such cells have a long life, and they resist being consumed. This provides a constant gap between the anode the cathode without requiring periodic adjustments. Such anodes usually comprise a substrate made of a valve metal such as titanium, tantalum, or niobium. The active face of the substrate has a coating that can be exemplified by a precious metal such as platinum, palladium, rhodium, iridium, ruthenium, and alloys and oxides thereof. The active face can also be a precious metal oxide, or a metal oxide such as magnetite, ferrite, or cobalt spinel, with or without a precious metal oxide. Despite the long life of these anodes, there is still the need for an anode having an active anode surface which is readily replaceable, or which has segments which are readily replaceable, in the event of damage to the anode or a part of the anode or so that the coating can be renewed, as for a spent anode.

Prior U.S. Patent No. 4,642,173 discloses an anode for electrolytic deposition of metal from an electrolytic solution onto an elongated strip of metal drawn longitudinally past the anode. The anode is submerged in the electrolytic solution and comprises an active surface which is directed towards the metal strip. The active surface comprises a plurality of lamellas supported so that they conform to the path of the metal strip. Only planar paths for the metal strip are disclosed. The lamellas are welded to a support and thus are not readily replaceable.

Prior U.S. Patent Application Serial No. 309,518, filed on February 10, 1989, assigned to assignee of the present application, discloses a substantially planar shaped and inflexible anode having a free face adapted to electrodeposit, for instance by electrogalvanizing, a coating onto a rapidly moving cathode such as a steel coil strip. The anode is desirably stable and is capable of maintaining a uniform spacing with a cathode. The anode comprises anode segments defining a broad flat anode face. At least one of the anode segments is bias cut in relation to the direction of travel of the cathode.

Prior U.S. Patent Application Serial No. 175,412, filed March 31, 1988, also assigned to assignee of the present application, discloses a massive and inflexible anode of generally planar shape which contains a mosaic of modular anodes. Each modular anode has an electrically conductive support plate serving as a current distributor for the modular anode. The modular anode has an active surface facing the strip being electroplated. A plurality of fasteners are welded to the opposite inactive face of each modular anode. The fasteners are, in turn, bolted to the support plate.

Prior U.S. Patent No. 4,119,115 discloses an apparatus for electroplating an elongated strip of metal drawn longitudinally past a positively charged anode assembly submerged in a bath of an electrolytic solution. The anode assembly comprises a plurality of flat segments which are bolted to a support frame. The segments can be vertically or horizontally arranged in the electrolytic bath. In the event of damage to one segment, that segment can be replaced without replacing the entire anode assembly.

SUMMARY OF THE INVENTION

The present invention in one aspect resides in an anode structure especially adapted for conformance with a cathode of unusual shape, which anode comprises a rigid support anode substructure member, said substructure member having a predetermined configuration; a resilient anode sheet element having an active anode surface; and means flexing said anode sheet element onto said anode substructure member so that said active anode surface conforms at least substantially to said anode substructure member configuration.

Preferred embodiments of the anode structure according to the invention are subject-matter of claims 2 to 17.

A further object of the invention is a method of making the anode structure of claim 1, which method comprises:

establishing a rigid support anode substructure (28) having a predetermined surface configuration;

providing a flexible anode (26) in sheet form and having an active anode surface (30), said flexible sheet anode (26) having a surface configuration different from the surface configuration of said support anode substructure (28); and

flexing said resilient sheet anode (26) into surface conforming relationship onto said support anode substructure (28) and electrically connecting said flexible sheet anode and substructure.

Other invention aspects include an electrolytic cell and an electroplating assembly.

An electrolytic cell according to the invention comprises

a cathode (18);

an anode (24) spaced from said cathode (18);

means for maintaining an electrolyte solution (16) between said cathode (18) and said anode (24);

said anode comprising at least one elongated valve metal anode strip (26) having an electrocatalytic coating, said anode strip (26) being flexible and having a formed first configuration;

support means for suporting said anode strip (26), said support means flexing said anode strip into a second supported configuration which is different from said formed first configuration.

In a preferred embodiment of the present invention, the electroplating cell is an electrogalvanizing cell and the cathode strip can be in strip form which may be a strip of steel. Also, in an embodiment of the present invention, the path of travel of a cathode covers a segment of a cylinder and the support anode substructure is radially disposed with respect to such path of travel and equidistantly displaced at all points from said path of travel. The anode sheet preferably comprises a plurality of segments independently held on the support anode substructure member.

BRIEF DESCRIPTION OF THE DRAWINGS

Further features of the present invention will become apparent to those skilled-in-the-art to which the present invention relates from reading the following specification with reference to the accompanying drawings, in which;

Fig. 1 is a schematic, elevation, section view of an electroplating cell for electroplating a continuous strip in accordance with the present invention;

Fig. 2 is an enlarged elevation section view of a portion of the electroplating cell of Fig. 1 showing the cell anode;

Fig. 3 is a plan view of the anode of Fig. 2, but with the anode turned 90° from its position in Fig. 2;

Fig. 4 is a section view showing a portion of the anode of Fig. 2 prior to assembly;

Fig. 5 is a section view showing a portion of the anode of Fig. 2 following assembly;

Fig. 6 is a partial elevation section view of an anode illustrating an embodiment of the present invention;

Fig. 7 is a partial elevation section view of an anode illustrating another embodiment of the present invention; and

Fig. 8 is a partial elevation section view of an anode illustrating a still further embodiment of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The electrolytic cell of the present invention is particularly useful in an electroplating process in which a deposit of a metal, such as zinc is made onto a moving cathode strip. An example of such a process is electrogalvanizing in which zinc is continuously galvanized onto a strip fed from a steel coil.

However, the electrolytic cell of the present invention can also be used in other electrodeposition processes, for instance plating other metals such as cadmium, nickel, tin, and metal alloys such as nickel-zinc, onto a substrate. The cell of the present invention can also be used in non-plating processes such as anodizing, electrophoresis, and electropickling, where a continuously moving strip of metal is passed through a cell bath. The anode of the electrolytic cell of the present invention can also be used in such non-plating applications as batteries and fuel cells, and in such processes as the electrolytic manufacturer of chlorine and caustic soda.

Referring to Fig. 1, the electrolytic cell 12 of the present invention comprises a cylindrical roller 1 which is at least partially immersed in an electrolytic bath 16. A continuous strip 18, for instance a strip of steel, is fed from a coil (not shown) into the bath and around the roller 14. The strip 18 functions, in the embodiment illustrated, as the cell cathode. Currents can be supplied to the strip 18 through the roller 14, or by other means well known in the electrodeposition art.

The cathode strip 18 moves circumferentially on the cylindrical roller 14. In the case of galvanizing, a strip such as of steel moves rapidly along a path of travel shown by arrow 20 which is defined by the cathode roller 14 and which generally conforms the surface of the roller 14.

The electrolytic cell 12 comprises an anode 24. Details of the anode are shown in Fig. 2. The anode 24 comprises an anode sheet 26 and an anode substructure 28. The anode sheet 26 has an active anode surface 30 which faces the cathode strip 18. Preferably, the active anode surface 30 is an electrocatalytic coating. Examples of electrocatalytic coatings are platinum or other platinum group metals such as palladium, rhodium, iridium, ruthenium, and alloys thereof. Alternatively, the active coating can be an active oxide such as a platinum group metal oxide, magnetite, ferrite, and cobalt-spinel. The active oxide coating can also be a mixed metal oxide coating developed for use as an anode coating in electrochemical processes. The platinum group metal and mixed metal oxides for the coatings are such as disclosed in U.S> Patent Nos. 3,265,526, 2,632,498, 3,711,385, and

4,528,084. The disclosures of these patents are incorporated herein by reference. Mixed metal oxides include at least one of the oxides of the platinum group in combination with at least one oxide of a valve metal or other non-precious metal.

The anode sheet 26 to which the active anode surface 30 is applied can be any metal which is suitably resistant to the electrolyte and is electrically conductive. Such metals include the valve metals such as titanium, tantalum, and niobium, as well as their aloys and intermetallic mixtures. Advantageously, for combining electrical conductivity with resistance to electrolyte, the sheet is titanium or a plated metal such as titanium clad copper, aluminum or steel.

The anode sheet 26 can be supplied as a thin gauge resilient rolled sheet having sufficient flexibility so that it can be flexed into an operative position using fasteners, e.g., the bolts 62 (Fig. 5), and a torque applied using hand operated tools. Also, it should have sufficient thickness to carry current from a current connection throughout the anode active surface 30, and sufficient strength or memory that it retains, in the absence of applied force, the shape imparted to it by rolling or other forming. Broadly, by way of example, the anode sheet 26 has a thickness of about 0.25 mm (0.01 inch) to about 12.7 mm (0.5 inch). A thin, coated titanium sheet rolled, or otherwise formed, preferably has a thickness of from about 2.54 mm (0.100 inch) to about 6.35 mm (0.25 inch). The thinner sheets of about 6.35 mm (0.25 inch) thickness or less can be easier to install and coat, and have a lower material cost.

In the embodiment of Fig. 2, the anode substructure 28 comprises end bars 36, 38 which extend the full width of the substructure 28, and an intermediate filler plate 40 which is positioned between the end bars 36, 38. The end bars 36, 38 and the filler plate 40 seat on a suitable flat support substrate 42. The support substrate 42 is not part of the present invention and is not described herein in detail, it being understood that such can be expected to be metallic, e.g., titanium, copper or steel. Together, the end bars 36, 38 and filler plate 40 define a concave upper surface which is machined or fabricated to very close tolerances to match the path of travel 20 of the cathode strip 18. By "matching", it is meant that the concave surface is substantially equidistantly spaced at all points from the path of travel 20 and concentric to the surface of the cathode roller 14.

As shown in Fig. 2, the end bars 36, 38 are bolted by means of spaced apart bolts 46 to the support substrate 42. The filler plate 40, in turn, is provided with flanges 50 (Fig. 4) which are secured to, by spaced apart screws 52, the inside seats 54 of the end bars 36, 38.

The anode substructure 28 broadly can be made of any material capable of being precision machined or fabricated to close tolerances, which is compatible with the chemical environment of the cell, and which provides electrical conductivity for current distribution to the anode sheet 26. The anode substructure 28 also should have sufficient mechanical strength to remain rigid while holding the anode sheet 26 in the desired shape. In the specific case of electrogalvanizing, the end bars 36, 38 are typically made of a valve metal and preferably of titanium or its alloys or intermetallic mixtures, while the filler plate 40 may be metallic or ceramic, but is preferably of a high strength plastic (polymeric) material which is resistant to the chemical environment of the cell. The titanium preferred end bars provide highly desirable current carrying capability as well as rigidity. It is however broadly contemplated to manufacture the entire substructure of end bars 36, 38 and filler plate 40 of titanium, or other valve metal, as well as to use one or more segments, rather than one solid piece for the filler plate 40. Other materials that may be used include clad or coated structures, for instance steel clad with titanium. Examples of suitable high strength polymeric materials for the filler plate 40 include polyhalocarbon polymers, e.g., polytetrafluoroethylene, polyamide polymers such as nylon and polyolefins such as ultra high molecular weight polyethylene.

As shown in Fig. 3, the anode sheet 26 is in the form of a plurality of segments 26a, 26b, and 26c, positioned side-by-side across the width of the anode. The segments are separated by lines of separation 34 that are biased with respect to the direction of travel of a cathode strip. This avoids unevenness of the plating of the strip due to edge effects. The anode sheet 26 is mounted over the filler plate 40, with its flanges 50 (Fig.4), as well as mounted over the end bars 36, 38.

Figs. 4 and 5 show a representative fabrication technique for one embodiment of the anode of the present invention. In this fabrication of the anode 24, the anode sheet 26 is formed with a radius which is less than the radius of the concave surface defined by the end bars 36,38 and the filler plate 40. In this way, the anode sheet 26 when placed upon the concave surface in an only partially flexed state, can have an about one to two millimeter gap 58 along the sheet edges as shown in Fig. 4. To conform the anode sheet 26 to the machined close tolerance concave surface of the sheet substrate, the edges of the anode sheet are flexed downwardly and secured to the end bars 36, 38 by means of bolts 62 (Fig. 5). Flexing the anode sheet down in this manner forces it to conform exactly to the concave surface of the anode substructure 28. Furthermore, securing the anode

sheet 26 in this way secures the end bars 36, 38 by the bolts 62 on the side of the anode sheet 26. This is removed from the active area of the anode sheet 26, thereby avoiding problems such as uneven plating due to fasteners. Also, the active anode surface need not extend to the side area under the bolts 62. It is also contemplated that a serviceable embodiment of the invention can be provided when the anode sheet 26 is formed with a radius of curvature which is greater than the radius of the concave surface defined by the end bars 36, 38 and the filler plate 40. The anode sheet 26 may then be only partially flexed to be in contact with, and fastened to, the end bars 36, 38. Such positioning will thereby retain a gap between the anode sheet 26 and the filler plate 40.

The current distribution to the anode sheet 26 is through the bolts 46 which secure the end bars 36, 38 to the support substrate 42. The connections (not shown) preferably are made such that the current is distributed in the direction of travel of strip 18. In the embodiment of Figs. 1-5, this is from end bar 38 to the anode sheet 26 to the end bar 36.

The present invention has advantages over other anode designs in that it allows the use of thin coated anode sheets which are more easily replaced and recoated than conventional anodes, as well as being less expensive than conventional anodes. The present invention also allows for replacing segments so that only spent or damaged anode sheet segments need to be replaced. The substructure 28, while being moderately expensive, need only typically be fabricated and installed once, and serves the functions of maintaining tolerances and distributing current. This allows a less critical tolerance, and less material, for the coated anode sheets. In conventional designs, the anodes are thick machined parts, each requiring the ability to carry current. The parts must be of high tolerance and thus higher costs. The thickness of the conventional anodes as well as the machined surfaces makes applying a long life high quality coating more difficult.

The present invention is applicable to substructures other than those having a concave configuration. For instance, the present invention can be used with anodes that are flat, or which have a convex configuration. For instance, for a flat anode, the anode substrate can be flat, and the anode sheet can be a cylindrical segment or curved so that it has to be flexed into conformity with the substructure surface. It is also contemplated that for a flat substructure and a cylindrical segment shaped anode, that the anode can be partially flexed or the like whereby it is mounted on a flat substructure but retains curvature such as for example to retain conformity with a complementary cathode curvature. In the case of a convex curved or cylindrical anode, the anode sheet may have a larger radius that the substructure. The anode sheet is then flexed into position by wrapping it around the substructure. In such case, the anode sheet would be placed in tension, for instance by a band clamp, to make it conform to the shape of the substructure.

An embodiment of the present invention is illustrated in Fig. 6. In this figure, the substructure 70 is a solid coated titanium plate in which opposed edges 72 are vertically aligned rather than at an angle as in the embodiments in Figs. 1-5. In the embodiment of Fig. 6 there is no filler plate insert between end bars. Furthermore, for enhancing electrical conductivity there is a voltage-minimizing coating 77 between the substructure 70 and the support substrate 42 at the bolt 46.

Figs. 7 and 8 illustrate still further embodiments of the present invention. In the embodiment of Fig. 7, the anode sheet 76 is fastened to the substructure 78 by means of flathead screws 80 countersunk into the surface of the anode sheet. At the juncture of the screws 80 with the substructure 78 there is a voltage-minimizing coating 77. A similar such coating 79 is placed between the substructure 78 and the support substrate 42 at the bolt 46. It is to be understood that such a coating 77, 79 is contemplated as being useful for the structure of any of the figures where a connection is obtained between electrically conducting elements. In the embodiment of Fig. 8, the anode sheet 82 is rolled to a desired radius and then fixed at this radius by welding the curved sheet 82 on its inactive side 84 to the substructure 86 as with the weld 88. The substructure 86 in this embodiment may be a plurality of spaced-apart curved I-beams which are suitably shaped and held together. The I-beams would serve as current distributors as well as the substructure support. The welding can be supplemented by using countersunk screws 89 for fastening the anode sheet 82 to the substructure 86. In an embodiment where the substructure 86 is apertured, the screws 89 could be replaced with studs, not shown, welded to the inactive side 84 of the anode sheet, and bolted from below within the apertures of the substructure 86. It is also contemplated that the countersunk screws 89, with or without studs, could be utilized when welding the anode sheet 76 to the substructure 78 and that brazing may also be employed when fastening the anode sheet 76 to the substructure 78. Usually, the use of removable metal fasteners, e.g., bolts and screws, is preferred where the anode sheet 26 is segmented and segments will be removed for refurbishing or replacement.

For the bolts 46 and 62, and the screws 52, 80 and 89, it is most desirable to use a highly conduc-

tive metal, e.g., copper. Such might be copper, copper alloy or steel, including stainless and high strength steel. Since copper metal might be subject to attack, as from the electrolyte in an electrogalvanizing environment, copper connectors will usually be covered, including cladding, plating, explosion bonding or welding, with a more inert metal, i.e., a valve metal. Where a voltage-minimizing coating is utilized, application by electroplating operation is preferred for economy, although other coating operations, e.g., brush plating, plasma arc spraying or vapor deposition, may be employed. For the metal titanium, e.g., when used as the anode sheet 76 and there will be a coating 77 between the sheet 76 and the substructure 78, it is advantageous to use a plated noble metal coating. Such a noble metal coating is a coating of one or more of the Group VIII or Group IB metals having an atomic weight of greater than 100, i.e., the metals ruthenium, rhodium, palladium, silver, osmium, iridium, platinum and gold. Preferably for efficiency in enhanced electrical contact, platinum plating is used.

Claims

1. An anode structure especially adapted for conformance with a cathode of unusual shape, which anode comprises:

   a rigid support anode substructure member (28), said substructure member having a predetermined configuration;

   a resilient anode sheet element (26) having an active anode surface (30); and

   means flexing said anode sheet element (26) onto said anode substructure member (28) so that said active anode surface (30) conforms at least substantially to said anode substructure member configuration.

2. The anode structure of claim 1, wherein said anode substructure member is segmented into end bar members connected by a filler plate member.

3. The anode structure of claim 1, wherein said end bar members are metal end bars and said filler plate member is a metal, ceramic or polymeric filler plate member.

4. The anode structure of claim 1, wherein said anode substructure member acts as a current distributor member for said anode sheet element.

5. The anode structure of claim 1, wherein said anode substructure member has a surface configuration shaped in conformance with a surface of an opposing cathode.

6. The anode structure of claim 3, wherein said metal end bar members are titanium, tantalum or niobium end bar members, or their alloys or intermetallic mixtures, and said filler plate member is a polyhalocarbon, polyamide or polyolefin filler plate member.

7. The anode structure of claim 1, wherein said anode sheet element is a thin, flexible coated metal plate.

8. The anode structure of claim 7, wherein said thin metal plate has an electrocatalytic coating on a broad face of said plate as said active anode surface.

9. The anode structure of claim 8, wherein said thin metal plate has a broad face opposite said active anode surface, which opposite broad face is in intimate, flexed contact with said anode substructure member.

10. The anode structure of claim 7, wherein said thin metal plate has thickness of from 0.25 mm (0.01 inch) to 12.7 mm (0.5 inch).

11. The anode structure of claim 1, wherein said anode sheet element is segmented with adjacent segments having opposing edges that are biased to the path of travel of a moving cathode.

12. The anode structure of claim 1, wherein said anode sheet element is a metal element of titanium, tantalum, niobium, their alloys or intermetallic mixtures.

13. The anode structure of claim 1, wherein said anode sheet element active anode surface conforms in shape with a surface of an opposing cathode and is secured to said anode substructure member by fasteners removed from the active area of the anode sheet element.

14. The anode structure of claim 1, wherein said cathode is a roller cathode and said anode surface prescribes an arc, spaced apart and in concentric relationship to said roller cathode.

15. The anode structure of claim 1, wherein said means flexing said anode sheet element onto said anode substructure member includes fastening means securely fastening said element to said member and said means includes weld, braze, screw, bolt or explosion bonding means.

16. The anode structure of claim 8, wherein said electrocatalytic coating contains a platinum group metal or contains at least one oxide selected from the group consisting of platinum group metal oxides, magnetite, ferrite and cobalt oxide spinel.

17. The anode structure of claim 8, wherein said electrocatalytic coating contains a mixed oxide material of at least one oxide of a valve metal and at least one oxide of a platinum group metal.

18. The method of making the anode structure of claim 1, which method comprises:
establishing a rigid support anode substructure (28) having a predetermined surface configuration;
providing a flexible anode (26) in sheet form and having an active anode surface (30), said flexible sheet anode (26) having a surface configuration different from the surface configuration of said support anode substructure (28); and
flexing said resilient sheet anode (26) into surface conforming relationship onto said support anode substructure (28) and electrically connecting said flexible sheet anode and substructure.

19. An electrolytic cell comprising
a cathode (18);
an anode (24) spaced from said cathode (18);
means for maintaining an electrolyte solution (16) between said cathode (18) and said anode (24);
said anode comprising at least one elongated valve metal anode strip (26) having an electrocatalytic coating, said anode strip (26) being flexible and having a formed first configuration;
support means for supporting said anode strip (26), said support means flexing said anode strip into a second supported configuration which is different from said formed first configuration.

20. The electrolytic cell of claim 19, wherein said anode support means has a concave configuration.

21. The electrolytic cell of claim 19, wherein said cell is an electrogalvanizing cell, electrotinning cell, or cell for copper foil finishing.

22. The electrolytic cell of claim 19, wherein said anode has an active anode surface radially disposed in concentric relationship with respect to a path of travel for said cathode.

23. The electrolytic cell of claim 22, wherein said anode is in segments, said segments being bias-cut with regard to said cathode path of travel,

24. The electrolytic cell of claim 19, wherein said anode has an initial radius prior to flexing which is less than the radius of said anode support

25. The electrolytic cell of claim 19, wherein said anode is removably bolted to said anode support.

26. The electrolytic cell of claim 22, further comprising current connections so that electric current is distributed into the anode sheet in the direction of said cathode path of travel.

27. The electrolytic cell of claim 26,wherein the current is distributed to said anode sheet through said anode support.

28. An anode for the electrolytic cell of claim 19, said anode being stable in an electrolyte and having an electrocatalytic coating on a material selected from the group consisting of valve metals and having a thickness by which said anode is flexible, said anode comprising the anode structure of claim 19 while including flange portions at anode edges which are angled with respect to said active anode surface, said flange portions being engageable by a support to hold said active anode surface in a desired configuration.

29. The anode of claim 28, wherein said configuration is curved.

30. An electroplating assembly comprising a moveable cathode (18) for receiving a metallic electrodeposited coating, an electrolyte (16) for providing said coating, means (14) guiding said cathode (18) so that it follows a predetermined path of travel in said electrolyte (16), said assembly further including the anode structure of claim 1.

Patentansprüche

1. Anodenstruktur, insbesondere eingerichtet zur Anpassung an eine Kathode mit ungewöhnlicher Formgebung, welche Anode umfaßt:
ein starres Anodenunterbauträgerelement (28), wobei das Unterbauelement eine vorbestimmte

Konfiguration hat,
ein biegsames Anodenblattelement (26) mit einer aktiven Anodenoberfläche (30), und
Mittel, die das Anodenblattelement (26) auf das Anodenunterbauelement (28) verformen, so daß die aktive Anodenoberfläche (30) mindestens weitgehend der Konfiguration des Anodenunterbauelements (28) angepaßt ist.

2. Anodenstruktur nach Anspruch 1, wobei das Anodenunterbauelement unterteilt ist in Endstangenelemente, die durch ein Füllplattenelement miteinander verbunden sind.

3. Anodenstruktur nach Anspruch 1, wobei die Endstangenelemente Metallendstangen sind und die Füllplatte ein Metall-, Keramik- oder Polymerfüllplattenelement ist.

4. Anodenstruktur nach Anspruch 1, wobei das Anodenunterbauelement als Stromverteilerelement für das Anodenblattelement wirkt.

5. Anodenstruktur nach Anspruch 1, wobei das Anodenunterbauelement eine Oberflächenkonfiguration hat, die angepaßt an eine Oberfläche einer gegenüberliegenden Kathode ausgeformt ist.

6. Anodenstruktur nach Anspruch 3, wobei die Metallendstangenelemente Titan-, Tantal- oder Niobendstangenelemente oder deren Legierungen oder intermetallische Gemischen sind, und wobei das Füllplattenelement ein Polyhalogenkohlenwasserstoff-, Polyamid- oder Polyolefinfüllplattenelement ist.

7. Anodenstruktur nach Anspruch 1, wobei das Anodenblattelement eine dünne, flexible beschichtete Metallplatte ist.

8. Anodenstruktur nach Anspruch 7, wobei die dünne Metallplatte auf einer Planfläche der Platte eine elektrokatalytische Beschichtung als die aktive Anodenoberfläche hat.

9. Anodenstruktur nach Anspruch 8, wobei die dünne Metallplatte eine Planfläche gegenüber der aktiven Anodenoberfläche hat, wobei die gegenüberliegende Planfläche in engem verformten Kontakt mit dem Anodenunterbauelement steht.

10. Anodenstruktur nach Anspruch 7, wobei die dünne Metallplatte eine Dicke von 0,25 mm (0,01 Zoll) bis 12,7 mm (0,5 Zoll) hat.

11. Anodenstruktur nach Anspruch 1, wobei das Anodenblattelement unterteilt ist, wobei nebeneinanderliegende Segmente gegenüberliegende Kanten haben, die zur Wegstrecke einer sich bewegenden Kathode schräg sind.

12. Anodenstruktur nach Anspruch 1, wobei das Anodenblattelement ein Metallelement aus Titan, Tantal, Niob, deren Legierungen oder intermetallischen Gemischen ist.

13. Anodenstruktur nach Anspruch 1, wobei die aktive Anodenoberfläche des Anodenblattelements in der Formgebung einer Oberfläche einer gegenüberliegenden Kathode entspricht und an das Anodenunterbauelement mit Festhaltemitteln befestigt ist, die von der aktiven Fläche des Anodenblattelements abgesetzt sind.

14. Anodenstruktur nach Anspruch 1, wobei die Kathode eine Walzenkathode ist und die Anodenoberfläche einen Bogen beschreibt, der in Abstand und konzentrisch zu der Walzenkathode angeordnet ist.

15. Anodenstruktur nach Anspruch 1, wobei das Mittel um das Anodenblattelement auf das Anodenunterbauelement zu verformen ein Festhaltemittel umfaßt, das das Element sicher an dem Element befestigt und wobei das Mittel ein Schweiß-, Löt-, Schrauben-, Bolzen- oder Explosionsbindemittel umfaßt.

16. Anodenstruktur nach Anspruch 8, wobei die elektrokatalytische Beschichtung ein Metall der Platingruppe enthält, oder mindestens ein Oxid enthält, ausgewählt aus der Gruppe bestehend aus Metalloxiden der Platingruppe, Magnetit, Ferrit oder Cobaltoxidspinell.

17. Anodenstruktur nach Anspruch 8, wobei die elektrokatalytische Beschichtung ein Mischoxidmaterial aus mindestens einem Oxid eines Ventilmetalls und mindestens einem Oxid eines Platingruppenmetalls enthält.

18. Verfahren zum Herstellen der Anodenstruktur nach Anspruch 1, welches Verfahren umfaßt:
Einrichten eines starren Anodenunterbauträgers (28), mit einer vorbestimmten Oberflächenkonfiguration,
Bereitstellen einer flexiblen Anode (26) in Blattform mit einer aktiven Anodenoberfläche (30), wobei die flexible Blattanode (26) eine Oberflächenkonfiguration hat, die unterschiedlich zur Oberflächenkonfiguration des Anodenunterbauträgers (28) ist, und

Verformen der biegsamen Blattanode (26), so daß die Oberfläche dem Anodenunterbauträger (28) angepaßt ist, und elektrisches Verbinden der flexiblen Blattanode und des Unterbaus.

19. Elektrolytische Zelle, umfassend
eine Kathode (18),
eine von der Kathode (18) in Abstand angeordnete Anode (24), Mittel zum Halten einer Elektrolytlösung (16) zwischen der Kathode (18) und der Anode (24),
wobei die Anode mindestens einen länglichen Ventilmetallanodenstreifen (26) mit einer elektrokatalytischen Beschichtung umfaßt, wobei der Anodenstreifen (26) flexibel ist und eine ausgeformte erste Konfiguration hat,
Trägermittel zum Halten des Anodenstreifens (26) wobei die Trägermittel den Anodenstreifen in eine zweite gehaltene Konfiguration verformen, die von der ausgeformten ersten Konfiguration verschieden ist.

20. Elektrolytische Zelle nach Anspruch 19, wobei das Anodenträgermittel eine konkave Konfiguration hat.

21. Elektrolytische Zelle nach Anspruch 19, wobei die Zelle eine elektrogalvanisierende Zelle, eine Zelle zur galvanischen Verzinnung oder eine Zelle zur Kupferfolienfertigung ist.

22. Elektrolytische Zelle nach Anspruch 19, wobei die Anode eine aktive Anodenoberfläche hat, die radial konzentrisch in Bezug auf eine Wegstrecke der Kathode angeordnet ist.

23. Elektrolytische Zelle nach Anspruch 22, wobei die Anode in Segmenten vorliegt, wobei die Segmente in Bezug auf die Kathodenwegstrekke schräg geschnitten sind.

24. Elektrolytische Zelle nach Anspruch 19, wobei die Anode einen ursprünglichen Radius vor dem Verformen hat, der geringer ist als der Radius des Anodenträgers.

25. Elektrolytische Zelle nach Anspruch 19, wobei die Anode abnehmbar mit dem Anodenträger mit Bolzen verbunden ist.

26. Elektrolytische Zelle nach Anspruch 22, weiterhin umfassend Stromverbindungen, so daß elektrischer Strom in der Richtung der Kathodenwegstrecke in das Anodenblatt geleitet wird.

27. Elektrolytische Zelle nach Anspruch 26, wobei der Strom über den Anodenträger zum Anodenblatt geleitet wird.

28. Anode für die elektrolytische Zelle nach Anspruch 19, wobei die Anode in einem Elektrolyten beständig ist und eine elektrokatalytische Beschichtung auf einem Material ausgewählt aus der Gruppe bestehend aus Ventilmetallen hat und eine Dicke hat, bei der die Anode flexibel ist, wobei die Anode die Anodenstruktur von Anspruch 19 umfaßt, während sie Flanschteile an Anodenkanten die in Bezug auf die aktive Anodenoberfläche winkelig sind enthält, wobei die Flanschteile mit einem Träger in Eingriff gebracht werden können um die aktive Anodenoberfläche in einer gewünschten Konfiguration zu halten.

29. Anode nach Anspruch 28, wobei die Konfiguration gekrümmt ist.

30. Elektrobeschichtungsanordnung, umfassend eine bewegliche Kathode (18) zur Aufnahme eines metallischen galvanisch abgeschiedenen Überzugs, eines Elektrolyten (16) zum Bereitstellen der Beschichtung, Mittel (14) zum Führen der Kathode (18), so daß sie einer vorbestimmten Wegstrecke in dem Elektrolyten (16) folgt, wobei die Anodnung weiterhin die Anodenstruktur von Anspruch 1 umfaßt.

Revendications

1. Une structure d'anode spécialement adaptée pour se conformer à une cathode de forme inhabituelle, cette anode comprenant :
un élément de base d'anode (28) constituant un support rigide, cet élément de base ayant une configuration prédéterminée ;
un élément de tôle d'anode flexible (26) ayant une surface d'anode active (30) ; et
des moyens courbant l'élément de tôle d'anode (26) sur l'élément de base d'anode (28), de façon que la surface d'anode active (30) se conforme au moins en majeure partie à la configuration de l'élément de base d'anode.

2. La structure d' anode de la revendication 1, dans laquelle l'élément de base d'anode est segmenté en éléments de barres d'extrémités reliés par un élément de plaque de remplissage.

3. La structure d'anode de la revendication 1, dans laquelle les éléments de barres d'extrémités sont des barres d'extrémités en métal et l'élément de plaque de remplissage est un élément de plaque de remplissage en métal, en céramique ou en polymère.

4. La structure d'anode de la revendication 1, dans laquelle l'élément de base d'anode remplit la fonction d'un élément de répartition de courant pour l'élément de tôle d' anode.

5. La structure d' anode de la revendication 1, dans laquelle l'élément de base d' anode a une configuration de surface qui se conforme à une surface d'une cathode en regard.

6. La structure d'anode de la revendication 3, dans laquelle les éléments de barres d'extrémités en métal sont des éléments de barres d'extrémités en titane, en tantale ou en niobium, ou en leurs alliages ou composés intermétalliques, et l'élément de plaque de remplissage est en polymère d'hydrocarbure halogéné, en polyamide ou en polyoléfine.

7. La structure d'anode de la revendication 1, dans laquelle l'élément de tôle d'anode est une plaque de métal mince, flexible et revêtue.

8. La structure d'anode de la revendication 7, dans laquelle la plaque de métal mince porte sur une face large un revêtement électrocatalytique qui constitue la surface d'anode active.

9. La structure d'anode de la revendication 8, dans laquelle la plaque de métal mince a une face large opposée à la surface d'anode active, et cette face large opposée est en contact intime, dans un état courbé, avec l'élément de base d'anode.

10. La structure d'anode de la revendication 7, dans laquelle la plaque de métal mince a une épaisseur de 0,25 mm (0,01 pouce) à 12,7 mm (0,5 pouce).

11. La structure d'anode de la revendication 1, dans laquelle l'élément de tôle d'anode est segmenté et des segments adjacents comportent des bords opposés qui sont coupés en biais par rapport au chemin de déplacement d'une cathode mobile.

12. La structure d'anode de la revendication 1, dans laquelle l'élément de tôle d'anode est un élément en métal choisi parmi le titane, le tantale, le niobium, leurs alliages ou leurs composés intermétalliques.

13. La structure d'anode de la revendication 1, dans laquelle la surface d'anode active de l'élément de tôle d' anode a une forme qui se conforme à une surface d'une cathode en regard, et elle est fixée à l'élément de base d'anode par des éléments d'assemblage qui sont hors de la zone active de l'élément de tôle d'anode.

14. La structure d'anode de la revendication 1, dans laquelle la cathode est une cathode cylindrique et la surface d'anode forme un arc, espacé et concentrique par rapport à la cathode cylindrique.

15. La structure d'anode de la revendication 1, dans laquelle les moyens qui courbent l'élément de tôle d'anode sur l'élément de base d'anode comprennent des moyens d' assemblage qui fixent fermement l'élément de tôle d'anode sur l'élément de base d'anode, et ces moyens comprennent des moyens de fixation par soudage, brasage, vis, boulon ou explosion.

16. La structure d'anode de la revendication 8, dans laquelle le revêtement électrocatalytique contient un métal du groupe du platine ou contient au moins un oxyde sélectionné dans le groupe qui comprend les oxydes de métaux du groupe du platine, la magnétite, le ferrite et l'oxyde de cobalt-spinelle.

17. La structure d' anode de la revendication 8, dans laquelle le revêtement électrocatalytique contient un matériau consistant en un oxyde mélangé qui est formé par au moins un oxyde d'un métal de la famille comprenant le titane, le tantale et le niobium, et au moins un oxyde d'un métal du groupe du platine.

18. Le procédé de fabrication de la structure d'anode de la revendication 1, ce procédé comprenant les étapes suivantes :

on établit une base d'anode de support rigide (28) ayant une configuration de surface prédéterminée ;

on fournit une anode flexible (26) sous la forme d'une tôle et ayant une surface d'anode active (30), cette anode en tôle flexible (26) ayant une configuration de surface qui diffère de la configuration de surface de la base d'anode de support (28) ; et

on courbe l'anode en tôle flexible (26) sur la base d'anode de support (28) de manière que sa surface se conforme à celle de la base d'anode de support, et on connecte électriquement l'anode en tôle flexible et la base.

19. Une cuve à électrolyse comprenant

une cathode (18) ;

une anode (24) espacée par rapport à la cathode (18) ;

des moyens pour maintenir une solution d'électrolyte (16) entre la cathode (18) et l'anode (24) ;

l'anode comprenant au moins une bande d'anode allongée (26) en un métal de la famille comprenant le titane, le tantale et le niobium, portant un revêtement électrocatalytique, cette bande d'anode (26) étant flexible et ayant une première configuration formée ;

des moyens de support pour supporter la bande d'anode (26), ces moyens de support courbant la bande d'anode pour lui donner une seconde configuration supportée, qui est différente de la première configuration formée.

20. La cuve à électrolyse de la revendication 19, dans laquelle les moyens de support d'anode ont une configuration concave.

21. La cuve à électrolyse de la revendication 19, dans laquelle la cuve est une cuve d'électrogalvanisation, une cuve d'électroétamage, ou une cuve pour la finition d'une pellicule de cuivre.

22. La cuve à électrolyse de la revendication 19, dans laquelle l'anode a une surface d'anode active qui est disposée radialement, selon une relation concentrique par rapport à un chemin de déplacement de la cathode.

23. La cuve à électrolyse de la revendication 22, dans laquelle l'anode se présente sous la forme de segments, ces segments étant coupés en biais par rapport au chemin de déplacement de la cathode.

24. La cuve à électrolyse de la revendication 19, dans laquelle l'anode a un rayon initial avant d'être courbée qui est inférieur au rayon du support d'anode.

25. La cuve à électrolyse de la revendication 19, dans laquelle l'anode est vissée de façon amovible sur le support d'anode.

26. La cuve à électrolyse de la revendication 22, comprenant en outre des connexions de courant pour distribuer du courant électrique dans la tôle d'anode, dans la direction du chemin de déplacement de la cathode.

27. La cuve à électrolyse de la revendication 26, dans laquelle le courant est distribué à la tôle d'anode à travers le support d'anode.

28. Une anode pour la cuve à électrolyse de la revendication 19, cette anode étant stable dans un électrolyte et ayant un revêtement électrocatalytique sur un matériau sélectionné dans le groupe comprenant notammment le titane, le tantale et le niobium, et ayant une épaisseur qui fait que l'anode est flexible, cette anode ayant la structure d'anode de la revendication 19 et comprenant

des rebords sur les bords de l'anode qui font un angle par rapport à la surface d'anode active, un support pouvant venir en contact avec ces rebords pour maintenir la surface d'anode active dans une configuration désirée.

29. L'anode de la revendication 28, dans laquelle la configuration précitée est courbe.

30. Un assemblage d'électrodéposition comprenant une cathode mobile (18) destinée à recevoir un revêtement métallique formé par électrodéposition, un électrolyte (16) pour former le revêtement précité, des moyens (14) qui guident la cathode (18) de façon qu'elle suive un chemin de déplacement prédéterminé dans l'électrolyte (16), cet assemblage comprenant en outre la structure d' anode de la revendication 1.

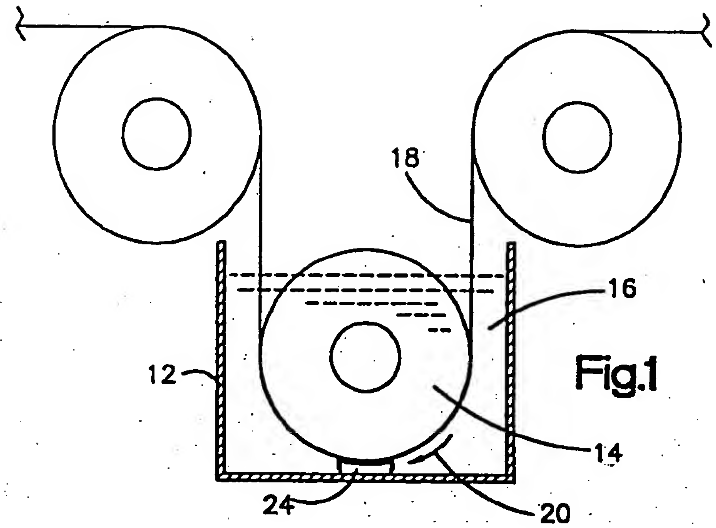

Fig.1

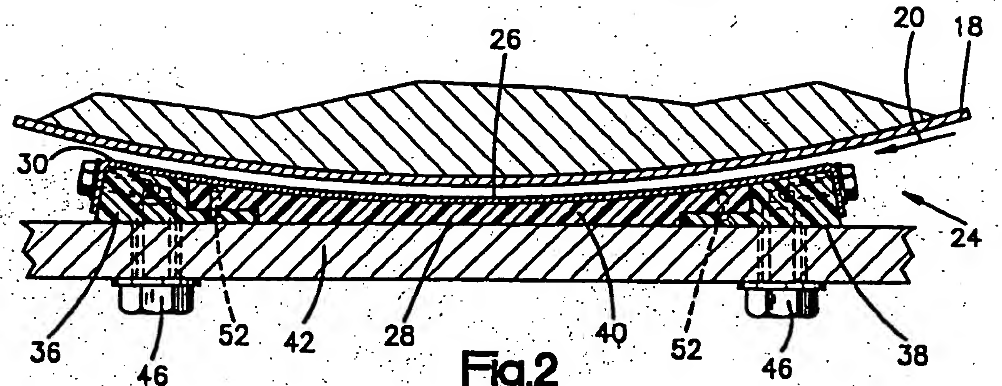

Fig.2

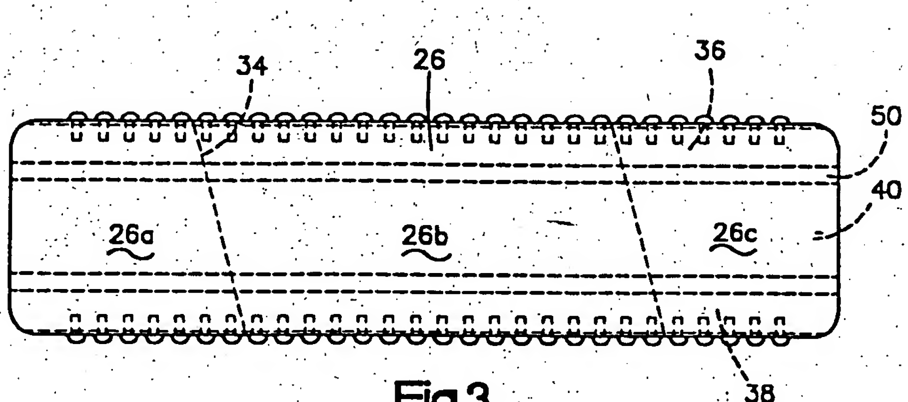

Fig.3

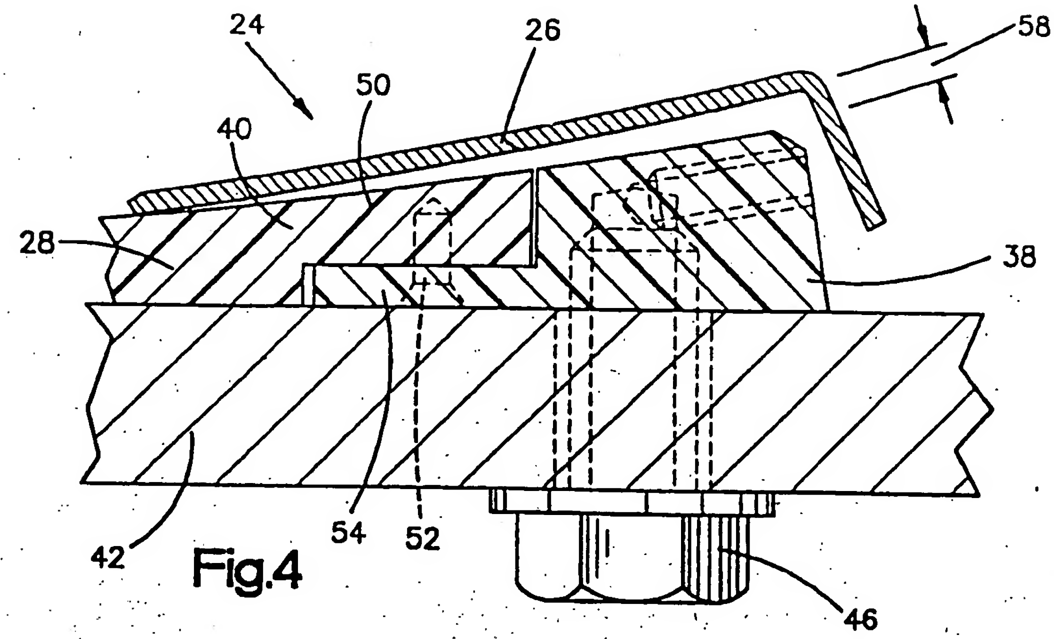

Fig.4

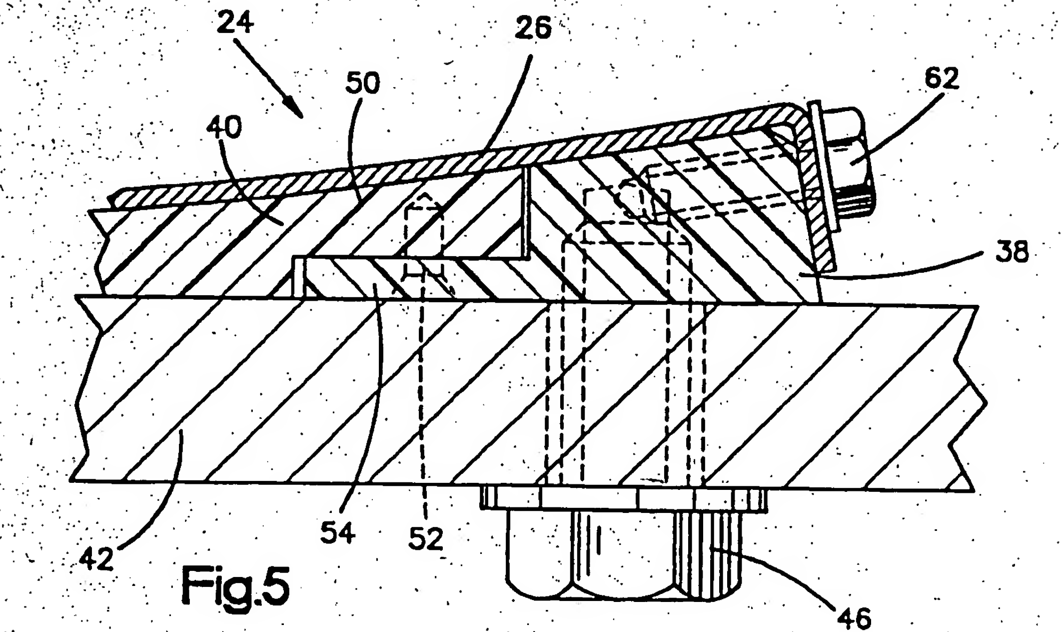

Fig.5

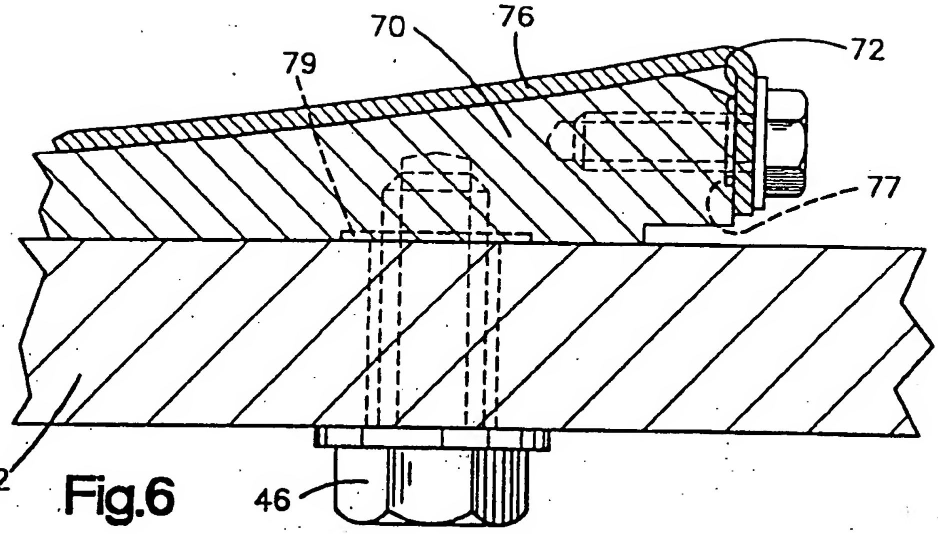

Fig.6

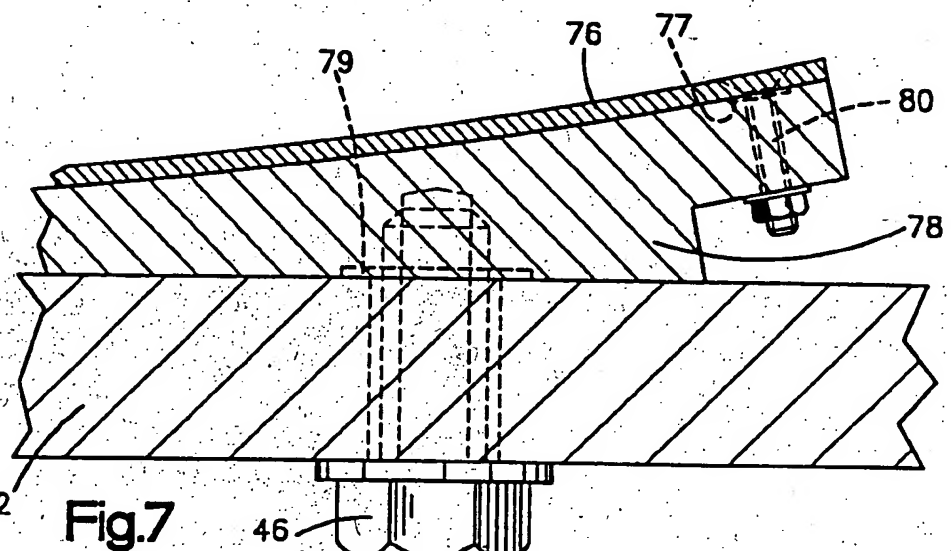

Fig.7

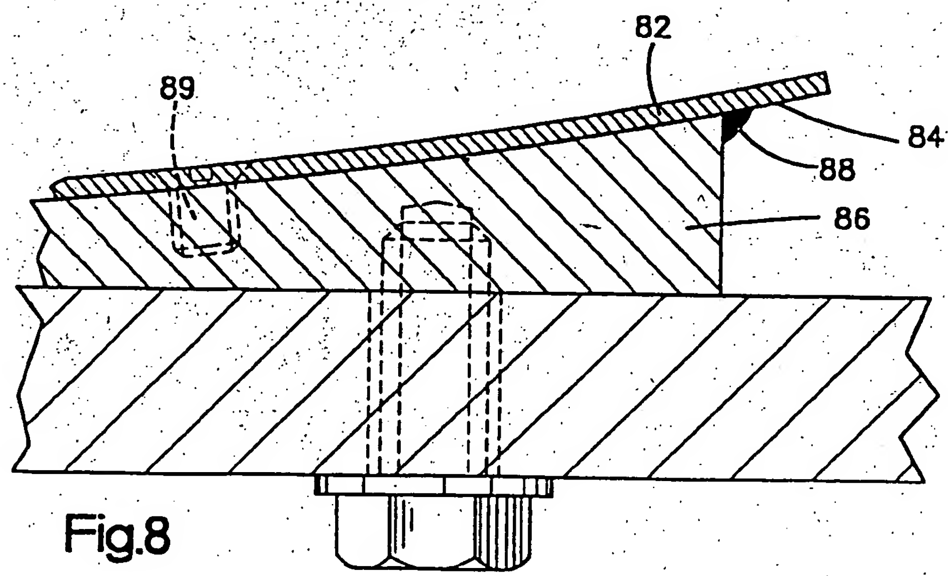

Fig.8